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The Polar Gas Pipeline: Update 1980

May 1980

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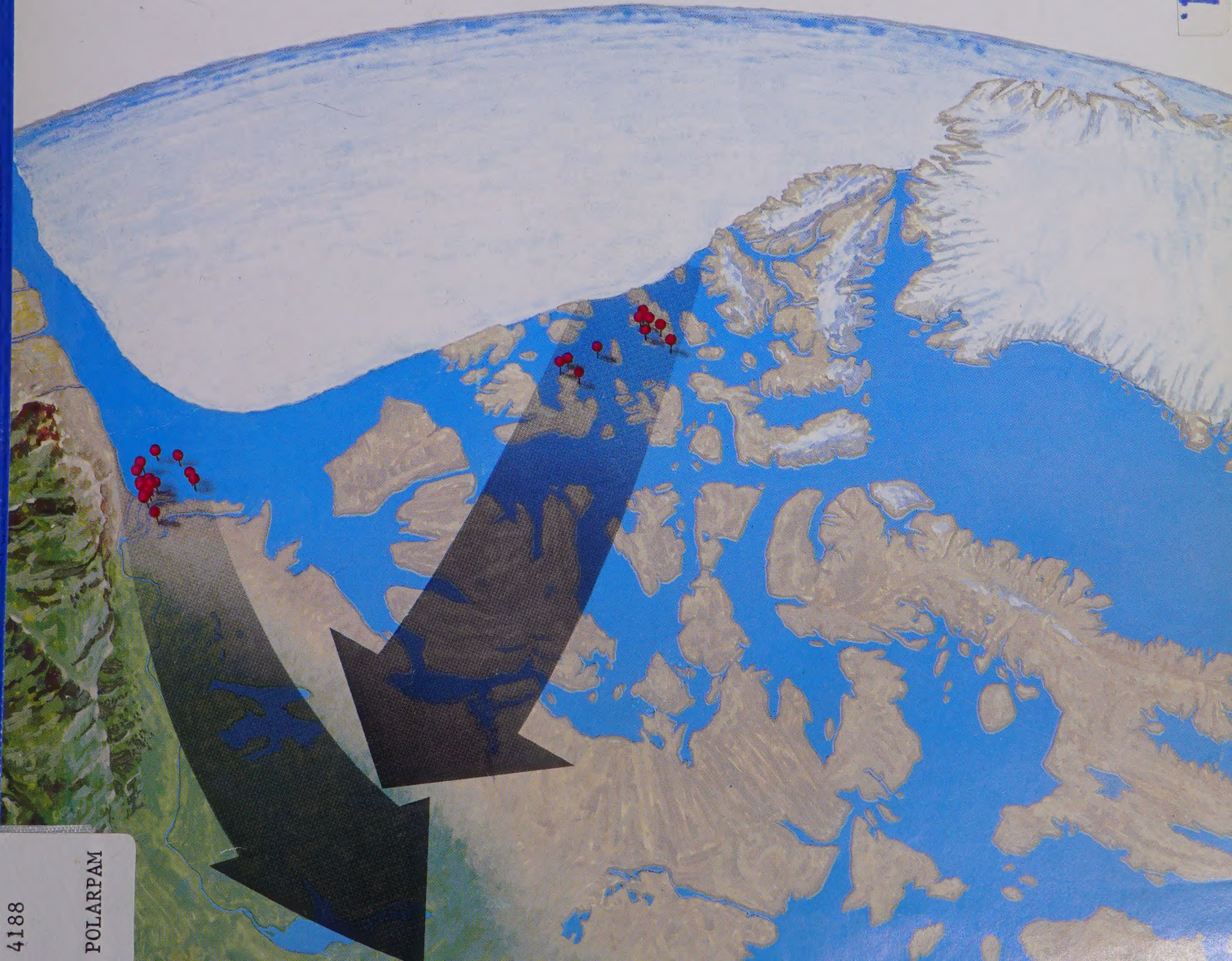
Current Arctic natural gas discoveries are pinpointed by red markers



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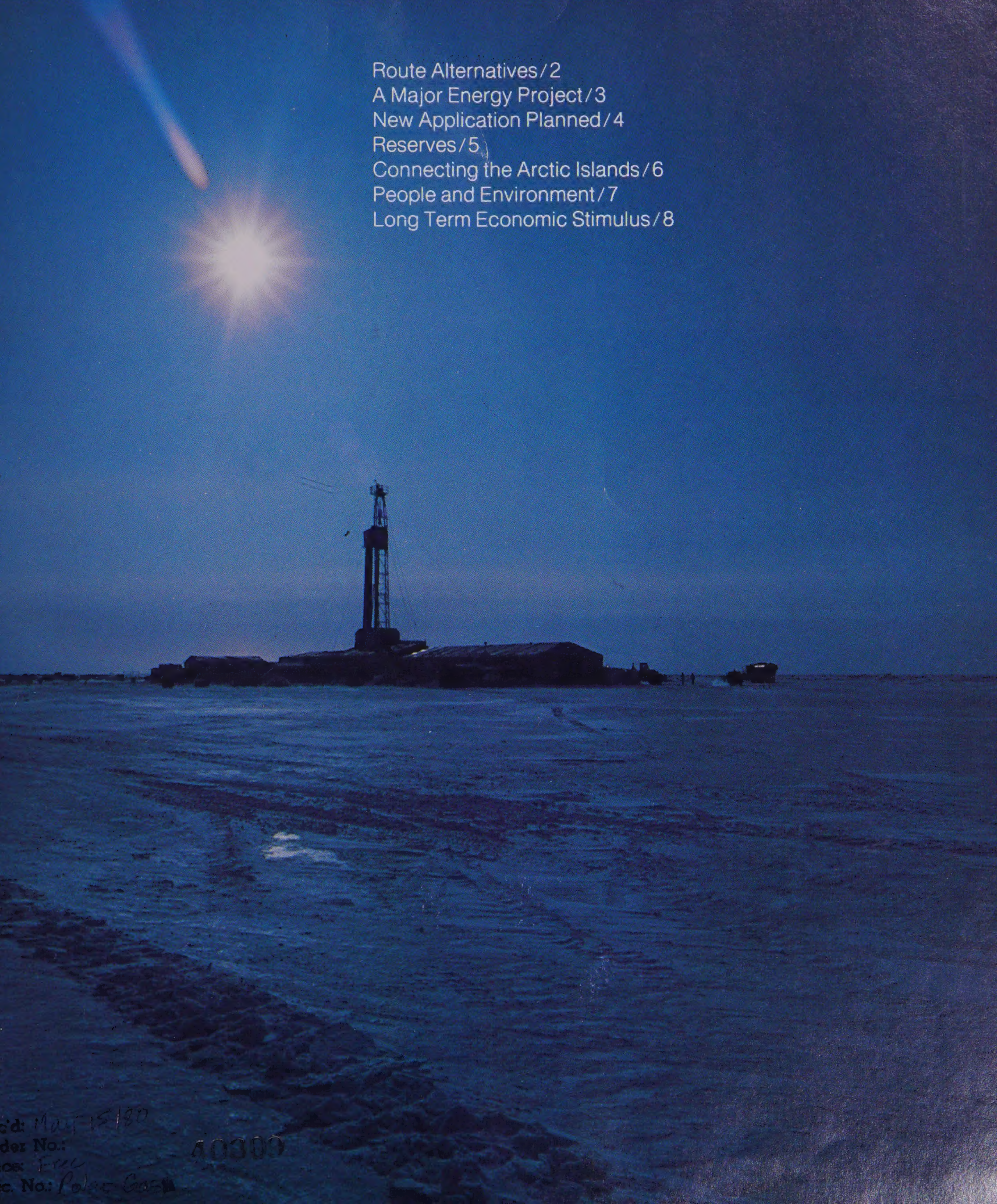

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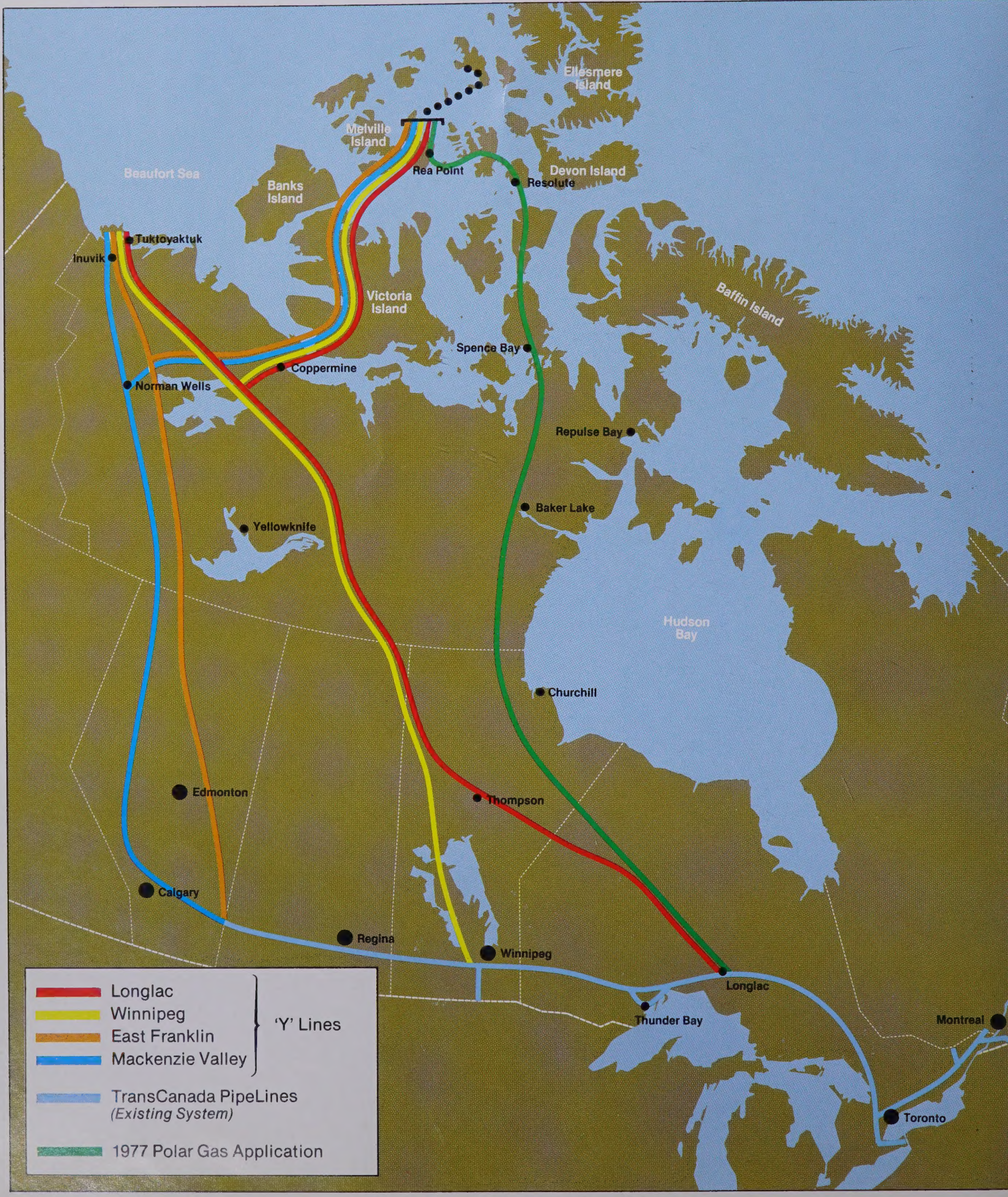
Route alternatives



A major energy project . . .
with national economic benefits

(Left) Stimulation of both primary and secondary manufacturing, real growth in GNP and reduction in unemployment levels are just some of the benefits that flow from construction of the Polar Gas pipeline.

(Below) Canadians are vulnerable to disruption in energy supplies or serious oil shortages as long as Canada is dependent on large volumes of imported oil.

(Above) The completion of the James Bay hydroelectric project demonstrates that large scale energy projects in Canada are financeable and manageable. While Polar Gas will deliver four times the energy equivalent of James Bay, it can be constructed for approximately the same cost.

There are only a few countries in the world with the potential to be energy independent. Canada is one of them. To achieve this energy independence, it is in Canada's best interests to accelerate development of domestic energy resources in the 1980s.

As long as Canada continues to import large volumes of oil, Canadians are vulnerable to disruptions in energy supplies or serious oil shortages. In addition, increasingly large payments to foreign nations for this costly imported oil can aggravate a potentially serious balance of payments problem.

However, by developing its own natural resources and by pursuing vigorous conservation measures, Canada will be able to look forward with confidence to an energy secure future.

Aggressive substitution of natural gas for oil will be part of the solution of this dilemma facing Canada. To encourage this trend, gas service is now being extended in areas where it is already available and major new pipelines have been proposed for Quebec and the Maritimes. At the same time, the export of surplus natural gas will earn many of the export dollars that will be needed to help pay for oil that must still be imported.

Significant benefits

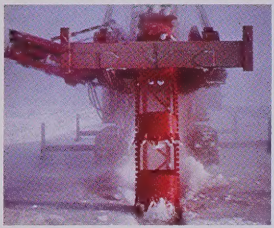
By connecting the abundant natural gas reserves of the Canadian Arctic frontier, Polar Gas can help Canada meet these challenges. At the same time, the construction and operation of the Polar Gas pipeline will have a significant, positive impact on the Canadian economy. Long term job creation, stimulus for both primary and secondary manufacturing, real growth in Gross National Product, a favourable impact on balance of payments and huge revenues flowing to governments are just some of the positive results to be expected.

However, it can take up to ten years before natural gas from the Canadian Arctic frontier can be flowing to southern markets. Today, most large energy projects require substantial lead times before coming into production. It took about a decade for each of Syncrude, Pickering and James Bay to bring energy onstream. Polar Gas will also take about ten years. During this time, the project must be reviewed by regulatory authorities. Then detailed design work follows. Financing arrangements must be completed, pipelining materials and other equipment ordered and transported to staging sites before construction finally gets underway.

So the time to act to meet Canada's energy needs for the late 1980s and beyond is now. Polar Gas is pressing to meet a target of connecting Arctic frontier gas to Canadian markets by the end of the decade in order to ensure that gas can be available when it is needed.

The Polar Gas pipeline . . .
new application planned

(Below) Ice strength tests have established that the Arctic ice provides a safe, dependable work surface for the heavy equipment that will be used to construct marine pipelines.



(Above) Over $70 million have been invested in Polar Gas studies. Here a ditcher cuts through the sea ice near Melville Island.

The Polar Gas Project began studies of the best means to transport Arctic frontier gas to market in 1972. Early studies concentrated on connecting the gas reserves of the High Arctic Islands to market. An application for a pipeline to transport these reserves was filed with the National Energy Board in 1977.

Since then advances in deep sea pipelaying technology have allowed Polar Gas to consider a new routing involving fewer marine crossings. This new routing would allow Polar Gas to transport Arctic Islands gas via M'Clure Strait and Dolphin and Union Strait to the Canadian mainland. This reduces the number of deep water crossings from five in the December 1977 application to two.

In the spring and summer of 1979, following six years of Arctic research, Polar Gas undertook additional field studies of these two straits. Detailed information was obtained on the channel bottom profiles, sub-bottom characteristics, ice conditions, tides and currents. No technical obstacles to marine pipelining were encountered at either strait.

Polar Gas has now advised the National Energy Board that it plans to select a new route and prepare a new application.

Four feasible options

The new application will be for a "Y"-Line which will connect the very substantial gas reserves of both the Arctic Islands and the Mackenzie Delta/Beaufort Sea areas to major Canadian and US markets. Four "Y"-Line routing options have been evaluated by Polar Gas. All are technically feasible. Following selection of a new "Y"-Line route, Polar Gas will press on with the timely development of a new application.

Depending on the final routing, the pipeline could involve 5,000 kilometres (3,000 miles) of pipe before it connects with the TransCanada PipeLines system in southern Canada. The several routes from the Arctic frontier to southern markets are shown on page two of this brochure. All routes pass through zones of continuous permafrost soils, discontinuous permafrost soils and non-permafrost soils.

The gas flowing through the pipe in the permafrost zone will be chilled below 0°C. This will prevent thawing of the permafrost soil. In the discontinuous zone, the pipeline will operate above 0°C. Here, construction methods will be designed to accommodate possible thaw settlement. In the non-permafrost zone the pipeline will operate above 0°C and conventional construction methods will be used.

Over $70 million invested

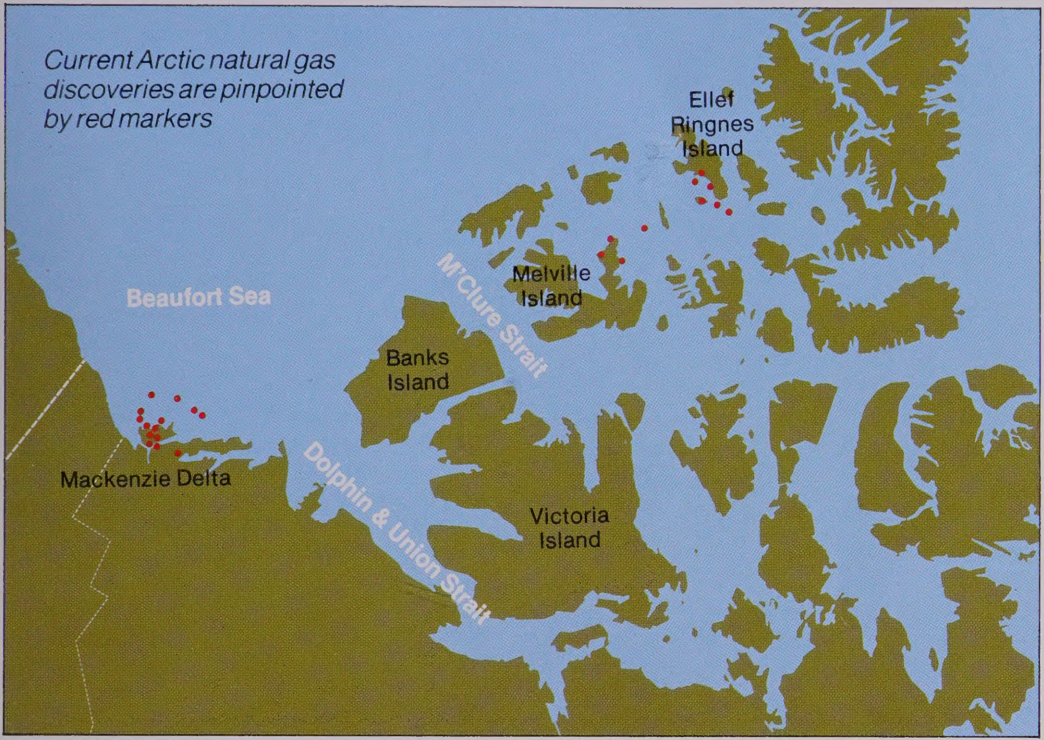
The Polar Gas pipeline proposals are based on substantial research. Over 70 million dollars have already been invested in technical, environmental, socio-economic and other feasibility studies. Research by Polar Gas staff and consultants will continue through 1980.

Further consultation among those who have a stake in the consequences of building a Polar Gas pipeline is vital and every opportunity for consultation will be utilized. This dialogue will be ongoing through all phases of the development of the project.

(Below right) Field research in 1979 confirmed the technical feasibility of the two marine crossings required for any of the Polar Gas "Y"-Line routings.

Current reserves support a pipeline . . .

future potential substantial



(Below) Drillers probe the earth's crust for hydrocarbons. So far, more than 18.5 Tcf of marketable natural gas have been discovered on the Canadian Arctic frontier.

(Above) Exploration in the High Arctic is carried out year round. Winter is now the busiest time as offshore structures are drilled from rigs mounted on artificially thickened ice platforms.

Current reserves	
Arctic Islands	**12.7 Tcf***
Mackenzie Delta	**5.8 Tcf**
Total	**18.5 Tcf**

*Recent discoveries at Whitefish and Char are expected to add a further 3 to 6 Tcf.

Identified reserves of natural gas on the Canadian Arctic frontier are now sufficient to make a large diameter pipeline system economically feasible.

The largest volume of reserves discovered so far is located in the High Arctic Islands. The consultants to Panarctic Oils confirm current marketable reserves of 360 billion cubic metres (12.7 Tcf). This total excludes the Whitefish field, which is undergoing further drilling to fully evaluate the field's potential. The 1980 gas strike at the Char well is also excluded from this current reserve number. The largest single gas fields confirmed to date are the Drake and Hecla fields in the Melville Island supply area.

Mackenzie Delta gas reserves are estimated by Delta producers to be 160 billion cubic metres (5.8 Tcf). The largest fields established in the Delta area are Taglu, Parsons Lake and Niglintgak.

An extra boost

This brings the total current marketable reserves on the Canadian Arctic frontier to 525 billion cubic metres (18.5 Tcf). This very significant volume of gas reserves will increase substantially when the 1979 and 1980 strikes at Whitefish and Char have been more fully evaluated. Early estimates indicate that the Whitefish and Char fields are expected to add a further 85 to 170 billion cubic metres (3 to 6 Tcf).

Future potential of the Arctic frontier area that will be connected to the Polar Gas pipeline is very substantial. The federal Department of Energy, Mines and Resources, in a report published in 1977, estimated the ultimate potential (50% probability) of 1,699 billion cubic metres (60 Tcf) in the Delta/Beaufort Sea area. The same report indicates that the Arctic Islands ultimate potential is 1,444 billion cubic metres (51 Tcf). This offers a combined potential of 3,143 billion cubic metres (111 Tcf).

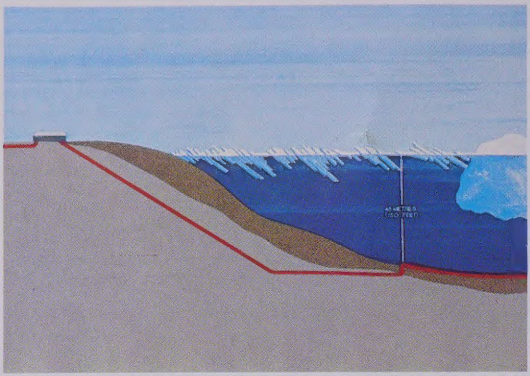
Continuing exploration by Panarctic Oils and others will result in additional discoveries which will enhance the already attractive economics of the pipeline.

Connecting Arctic Islands gas to the mainland . . .

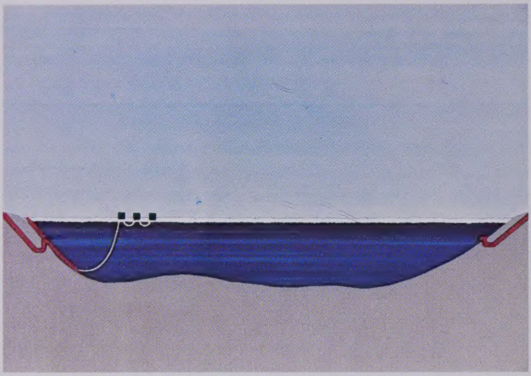
technical feasibility assured

(Above) In 1978, Panarctic Oils demonstrated that offshore Arctic wells can be completed and connected by a flow line to onshore facilities. Shown here is the rig-up of a 1,220 metre (4,400 foot) pipeline section that was pulled into place on the seabed near Drake Point on Melville Island.

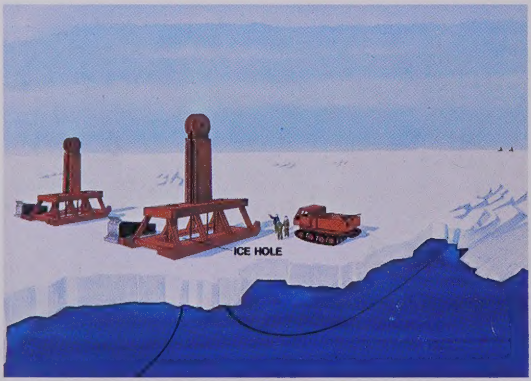
(Right: Top to Bottom)



Research by Polar Gas has determined that where ice islands may be present the pipe must be protected to 45 metres (150 feet) below sea level. Tunnelling offers the most secure method of protection.



On M'Clure Strait, between Melville and Victoria Islands, Polar Gas proposes to use pairs of pull units positioned on the ice to pull the pipeline strings into position on the sea bed.



Pairs of pull units, mounted above holes cut in the ice surface will advance the pipe strings across the channel

Laybarges can install pipe at great depths. In the Mediterranean, pipelines are being installed in 640 metres (2,100 feet) of water.

Polar Gas has developed an improved method for constructing a marine pipeline under ice covered waters. The project plans to apply this method in M'Clure Strait between Melville and Victoria Islands in the High Arctic. Under study for the past two years, this method allows for the pipeline strings to be pulled into place by pull units mounted on the channel ice surface. The ice thickness on M'Clure Strait varies between 2 and 12 metres (7 and 40 feet) and provides a solid dependable working surface for at least 90 days in the spring of each year.

The long pipe sections will be assembled at make up yards on the shore line. Each of these sections will be close to two kilometres in length and several sections will be welded together to form a single pipe string. Each pipe string will be about 20 kilometres (12 miles) in length when fully assembled.

In order to connect the pipe string by cable to the pull unit on the ice surface a series of ice holes will be cut into the surface from one shore to the other. This feature gives the method its name — the "ice hole bottom pull" method.

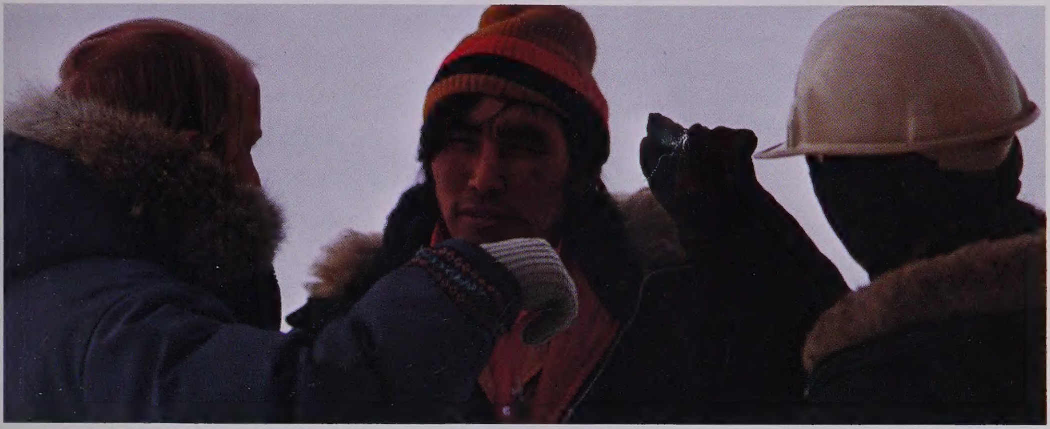
Technical feasibility assured

Once the pipe strings are in position on the sea bed, they must be connected together. Several feasible methods are available including one atmosphere and hyperbaric welding as well as mechanical tie-ins.

Ensuring that the pipeline is not scoured by ice is a further important consideration. Early research by Polar Gas determined that where ice islands may be present the pipe must be protected to 45 metres (150 feet) below sea level. Tunnelling provides the most secure method of protection and Polar Gas proposes to tunnel down to at least 45 metres below sea level and then use a subsea riser to connect the pipe installed in the tunnel to the pipeline laid on the sea bed.

This combination of techniques would be applied to pipeline across M'Clure Strait from Melville Island to Victoria Island. To complete the connection of the Arctic Islands gas reserves to the mainland of Canada a second marine pipeline is proposed at Dolphin and Union Strait. During August and September this particular channel is ice free and the pipeline would be constructed using a laybarge or pullbarge. This technology is well established on a world scale and would be appropriate to conditions in this strait.

People and environment . . .
consultation and protection



(Left) Consultation and dialogue with people who live in communities that may be near the pipeline route is an essential activity.

Environmental protection

Environmental protection has been, and continues to be, a significant ongoing concern in planning the Polar Gas pipeline. The first step in this essential process is to identify potential conflicts between the pipeline project and the environment and, wherever possible, to deal with the challenge by changes in Polar Gas plans. Where conflicts cannot be avoided completely, Polar Gas planning is designed to hold impacts within acceptable limits.

This process which was an integral part of the development of the earlier Polar Gas application (December, 1977) is being applied to planning for the new Polar Gas "Y"-Line system. For example, when project staff first tackled the matter of a new route to link Delta gas reserves into a Polar Gas pipeline, it appeared that the easiest route from the Delta would be along the Arctic coast. However, environmental studies have shown a potential conflict with important areas for caribou, muskox and waterfowl. In this case the solution was to move the route inland about 160 km (100 miles).

Environmental studies are ongoing through 1980, including field work in areas where relatively little has been studied to date. Caribou studies between Great Bear Lake and the Amundsen Gulf began in late winter of this year and will conclude in the fall of 1980. Field studies on Victoria Island will also extend Polar Gas knowledge. Information gathered in these studies will be used in further planning and design of the pipeline to ensure maximum environmental protection.

Socio-Economic concerns

Studies of socio-economic issues are also an ongoing part of Polar Gas planning. So far these studies have helped to identify the complex balance of socio-economic costs and benefits. Clearly, the more remote routings avoid resource harvesting areas and have the least potential for social disruption in communities. On the other hand, closeness to communities offers the potential to provide greater economic opportunities for local residents.

An essential part of socio-economic planning is the development of an appropriate set of social policies and programs. In order to develop policies and programs to be included in the new Polar Gas "Y"-Line application, project staff will use the policy proposals developed for the original application as a basis for consultation and dialogue with communities, native organizations and governments.

Polar Gas recognizes that, overall, the most important socio-economic issue on all routes is the resolution of native claims and the associated lifestyle concerns. Polar Gas believes that a just settlement of these claims and the resolution of constitutional development issues in the North will provide the best climate for consideration of development projects.

Community consultation

Consultation and dialogue with communities and representative associations will continue in preparation for a preferred routing decision and during the development of a new application.

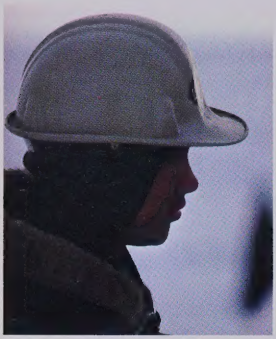
These initiatives are opening up channels of communication so that concerns of community residents are kept before Polar Gas management. At the same time, northern residents can learn more about Polar Gas plans and proposals. In areas where environmental and socio-economic studies are taking place special efforts are being made to have community discussions. The results of these studies are made available to communities and native organizations.

(Below) Socio-economic studies include both isolated northern communities and more accessible southern cities.

(Above) Environmental studies identify potential conflicts and provide information that is needed for effective project planning.

Provides significant, long term economic stimulus . . .
with major economic benefits to all Canadians

(Below) The pipeline will provide a wide variety of job opportunities both during construction and the operations phases.



(Above) The pipeline project will provide a major impetus to employment creation in manufacturing and service industries.

(Right) The Canadian steel industry will receive a major boost due to the large tonnages of steel pipe and other steel components needed for the construction of a pipeline from the Arctic frontier to southern markets.

A Polar Gas pipeline will provide very substantial, ongoing economic benefits to Canadians by connecting the untapped natural gas discoveries on the Canadian Arctic frontier.

Beginning during the construction phase and continuing over its life, the project has the potential to generate enormous benefits for all Canadians. The positive impact of Polar Gas on the Canadian economy will be greater than that of any other resource project in the history of Canada. At the same time, it will make a major contribution to Canada's goal of attaining energy independence.

The range of economic benefits is convincing and impressive. A Polar Gas pipeline can generate enough jobs to reduce Canadian unemployment by one percent during the five year construction period. The economic stimulus associated with Polar Gas will continue after construction and create many thousands of additional job opportunities.

During construction Gross National Product will rise between one and two percent. Maximum use of Canadian goods and services will assure wide distribution of the benefits associated with the pipeline. Billions of dollars in taxes and royalties will flow to governments to be recycled through the economy.

In addition, the Project will have a large and beneficial impact on Canada's balance of payments. Either by substitution of gas for oil or by exports of surplus natural gas, the pipeline will help to improve Canada's potentially deteriorating balance of payments position.

Employment
During construction of the pipeline, 250,000 man years of employment are generated directly by Polar Gas. In addition, another 45,000 man years of employment are created by the construction of gas gathering and processing facilities and downstream gas transmission and distribution systems.

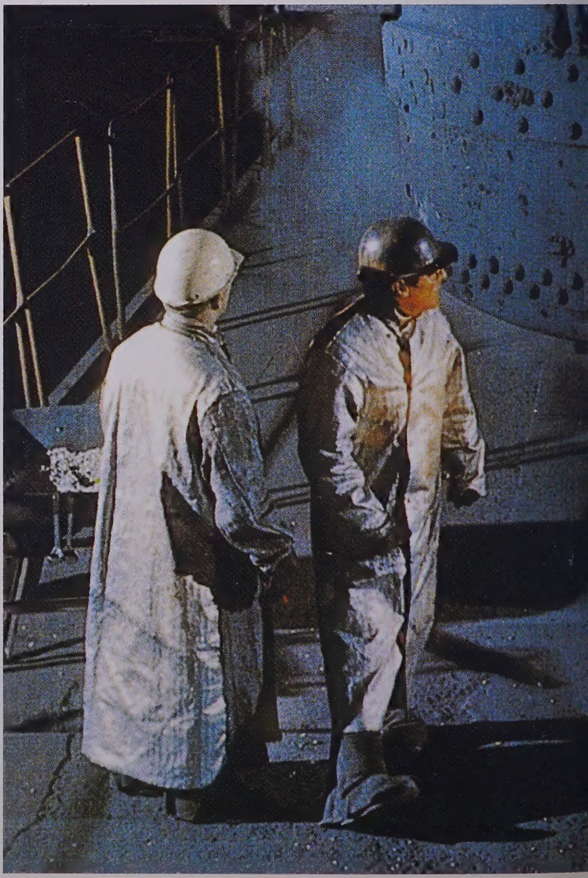
As a result of all this activity, a "multiplier" effect is induced in the economy increasing the number of man years of employment during the construction period to 610,000. This has the effect of reducing the national unemployment rate by approximately one percentage point.

Over the operating life of the Polar Gas pipeline, 80,000 to 145,000 jobs per year can be attributed to the Project. Some of these jobs will be related directly to the operation of the pipeline. The development and production of gas discoveries on the Arctic frontier will also create many jobs. Further exploration will be stimulated which in turn will generate additional

Economi

During construction
Employment (Man years) *Direct and indirect* *Including multiplier effect*
Unemployment reductions
GNP Addition

During initial 20-year operating life
Employment (Annual man years)
Unemployment reductions
GNP Addition



enefits

248,000 612,000
1.0%
1.5%
80,000 increasing to 145,000
0.5% increasing to 1.0%
1.0%

job opportunities. Finally, real income from the operation of the Polar Gas pipeline can be reinvested in other sectors of the economy generating many thousands more new jobs.

GNP

The building of the Polar Gas pipeline will account for a real increase in the Gross National Product of between one and two percent during the construction phase (due to income generation and re-investment). Once the pipeline is in operation the real increase will continue at about one percent. An important determining factor in the extent of growth of Canada's GNP will be the use that governments make of the large royalty and tax payments they will receive as a result of the pipeline operation.

Balance of payments

It is clear that the construction of the Polar Gas pipeline can have major positive impact on Canada's balance of payments, initially through improving our trade balance by an estimated $78 billion during the 1988-2000 period. The project will make a substantial contribution toward reducing Canada's oil import bill — both by making more gas available in Canada to substitute for imported oil and by earning gas export dollars for Canada to help offset the rapidly growing cost of oil imports.

In the near future, Canada may face a serious balance of payments problem because of the need to expand domestic energy supplies. This could require a great deal of foreign borrowing and the interest on these loans would only make Canada's balance of payments worse. Increased export earnings would be needed. Some of these could certainly come from the export of gas surplus to Canada's needs.

National perspective

Polar Gas will be one of the most significant and attractive energy projects of the 1980s. It has a high national rate of return on investment — which provides for real growth without the penalty of an equivalent inflationary increase. Regardless of which final routing is selected, procurement of materials and equipment needed for construction will be national. Alberta and Ontario will both be major beneficiaries.

The clear economic benefits associated with the Polar Gas pipeline demonstrate how a major energy resource project can both contribute to energy independence and provide strong positive stimulus to the national economy.

(Below) Polar Gas will encourage, and in some cases make feasible, the establishment of Canadian facilities to produce materials and equipment needed to construct the pipeline.

(Above) Engineering and management expertise developed by Polar Gas will become an important Canadian resource.

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